

A Guide to Composting

This resource provides more in-depth science and practical information about composting. It is the supplement to a garden class lesson (Hot compost: A Garden lesson) and activity (How to Make Hot Compost). It also contains extra information that is useful for the maths and science unit, 'Heat and Energy' (*Tools for Teachers 5 – Years 3&4*) and the science unit, 'Underground' (*Tools for Teachers 3 – Years 3&4*) – or for explorations of your own into science, geography, design technologies, health and mathematics. (For more curriculum ideas for years 1–7, see the end of this document.)

Beautiful decay

Most organic gardeners have a compost pile somewhere in the garden, quietly turning garden and kitchen scraps into rich nutrients to add to the soil.

Natural materials decay in the compost, helped along by micro-organisms such as bacteria, and larger organisms such as worms and nematodes.

Composting is simple, does not cost a lot or require specialist knowledge, and it is an excellent way to feed the soil. Well-fed soil equals well-fed, large and healthy plants. Finished compost holds water beautifully and helps to 'fluff' or aerate the soil, both of which make it easier for plant roots to grow strongly and to feed the plants.

Organic matter

Most soils contain organic matter. Think of a carpet of leaf litter, twigs and grass you might see under a tree, perhaps mixed with insect carcasses and frass (insect excrement), a bit of manure from animals and birds, shells of nuts or seed husks left by bird roosting in the tree above.

Over the course of months, this layer of organic material subsides and is replaced as more material drops on top. Worms and chomping insects break down the materials and pull them into their burrows in the soil. Fungi and bacteria further break down these little bits until eventually the bottom layers are virtually indistinguishable from soil – rich, dark soil, full of the nutrients in the organic matter.

Organic matter is only a small part of soil (1– 8% of total volume) but it is a major driving force behind fertility in the garden. Building up the organic matter in your garden soil therefore pays off in plant health.

Vocabulary

aerate
hydrate
friable
metabolism
metabolic energy
micro-organism

Ingredients

When we make a compost pile, we are copying nature, but we are also manipulating the environment to make sure that the process of decay goes quickly. The trick to building a compost pile is to create an environment that micro-organisms want to live in.

Micro-organisms need food, air, water and a degree of shelter (protection) from the extremes of heat and cold. We provide food in the wide variety of different types of materials we add. Air comes from holes between materials and at some points we turn over, lift and drop, or otherwise aerate the pile to provide air. Watering the compost heap provides moisture for micro-organisms to multiply, and by building the pile large enough, we are making sure that there is a core that is sheltered from extremes of heat and cold, where our happy micro-organisms can live and breed.

Cold compost

Rake together a pile of leaves and grass, and eventually it will decompose. It might take a few months, depending on the weather, but it will work. Many garden compost piles are cold compost and take almost a year to finish off. This is a perfectly reasonable approach and it is incredibly easy!

Hot compost

When we create a pile that encourages the micro-organisms to breed and multiply in huge numbers, each tiny living organism gives off just a little heat. When there are millions of them, the pile begins to grow warm.

It's like magic...

Actually, it's metabolism at work: living organisms eat food (the decaying material) and give off energy in the form of heat.

One of the tricks we use is to add small quantities of micro-organisms to start the pile off – this is why our compost recipe includes instructions to mix yoghurt, molasses or complete organic fertiliser (it must be organic) into warm water. A little garden soil will work, too.

Hot compost piles have a few major benefits: the extra action of all of those micro-organisms makes the material break down more quickly. The heat they generate kills weed seeds and diseases.

A well-structured hot compost can heat up to 70°C in the centre.

To test the temperature of the centre of the pile, plunge a stake or wooden handle into the pile, then (wearing gloves) insert the thermometer into the mass nearest the centre. Take a reading and see how it's going!

Turning the compost to add air can re-awaken a pile that is cooling and settling as this exposes new food to the community of micro-organisms.

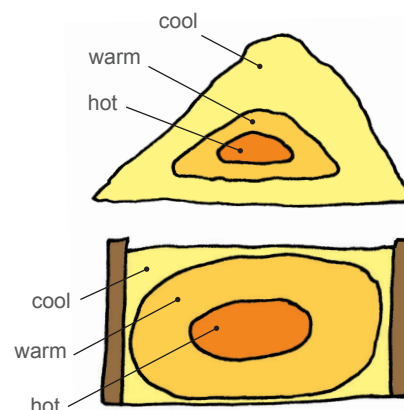
Eventually the pile cools off and bigger organisms like worms move in and finish it off. These animals like to be protected from light and birds, so when your compost cools off completely, put wet cardboard, a tarp or an old carpet over it and let it rest for 3–6 months while you are building a new pile. Turn it out and use it in the garden when it's crumbly and dark and you can no longer recognize any of the original materials.

The science behind 'greens' and 'browns'

All living things are made of carbon (C) plus a smaller amount of nitrogen (N) and other elements. The ratio of carbon to nitrogen in a living thing is called the 'carbon to nitrogen ratio' (C:N).

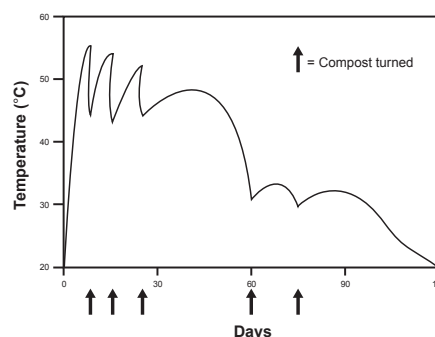
Scientists studying composting have worked out that a healthy compost heap should have a carbon to nitrogen ratio of about 25:1 or 30:1 – 25 to 30 times more carbon than nitrogen. The result is sweet-smelling, dark and crumbly compost – you know your compost is pretty good when it smells like sweet, warm, yeasty hay. If you've got too much nitrogen the pile will have a rotten smell.

Compost heap profiles



A square compost heap loses less heat from the sides.

Compost temperatures



This sounds complicated, but luckily there is an easy way to estimate the ideal proportion of carbon to nitrogen. We call things that are high in carbon ‘browns’ and things that are high in nitrogen ‘greens’. Carbon ‘browns’ slow down the decaying process and keep it from running out of balance, while nitrogen ‘greens’ decay quickly and activate the pile. It’s easy to remember:

‘Browns slow it down and greens keep it keen!’

Examples of compost styles

The minimum size for a compost pile is 1 m². This ensures the center provides a sheltered environment for micro-organisms. The shape of the compost can be a cylinder or a cube – even a heap (this shape cheaper but less effective). A barrel filled with compost can be rolled along the ground, aerating it (it needs a tight lid).

Compost tips

- It is not necessary to turn compost but this does make it mature faster. Turn over the pile when you can, mixing the outer materials to the middle. Multiple-bay composting systems make this easier.
- Compost piles work best when the ingredients are consistently layered, much like lasagne.
- The entire pile should rest on a foundation of loosened soil and a 5–10 cm layer of small branches. This ensures that it is well aerated and drains if it gets very wet.
- Add a little garden soil (a 0.5 cm thick layer) near the top of the pile to add micro-organisms if you like.
- If your compost smells bad, it needs more carbon and more air. Add any of the browns (sawdust, wood ash, hay) and stir and fluff it well to let air in. Go easy on the water – push on the pile and it should feel like a big dish sponge that has been wrung out, not like soggy porridge. (No squelching!)
- Manure should make up no more than 30% of a compost.
- Fresh chicken manure can be very high in nitrogen (i.e. very ‘green’), but when it is mixed with bedding that is high in carbon such as hay, straw or sawdust, it balances out and does not smell.
- Cover compost in rainy seasons or wet areas.
- ‘Chop and chat’ stations can let students cut larger pieces into small bits suitable for composting. Smaller pieces present a greater amount of surface area to microbial activity.

Materials to use in small amounts or not at all

Avoid plants infected with disease or severe insect infestation, and poisonous plants such as oleander, hemlock and castor beans. Some plants have waxy coatings and take too long to break down, such as magnolia leaves. Plants that have acids toxic to other plants and microbial life, such as eucalyptus and California bay laurel should be kept to a minimum. Avoid tubers (such as potatoes), bulbs (such as garlic bulbs), corms and runners (such as couch grass) – they might grow again unless they get hot and/or are very well chopped up. Avoid pernicious weeds, such as morning glory and Bermuda grass, that may not be killed by the composting process.

Sample activities:




- Bury sample objects made of organic materials (materials that were once alive): cardboard, natural fabric such as cotton, an apple core, a wooden spoon or stir-stick, a leather glove. Then dig them up one month, two months and three months later. Students observe and record their findings.
- Compare these results with objects made of inorganic materials (plastic, metal stone) buried at the same time: such as a plastic drink bottle, a metal spoon – or a composite item such as a running shoe.
- Design the ideal compost for a small urban block, considering materials as well as pests such as rats or possums. Write instructions for using it.
- Measure the compost temperature twice a week and graph the results over a term.
- Compare the temperatures of different compost styles, or of different positions in the same compost pile.

Curriculum links

Composting can be used to teach many things. We can explore materials (what decays; what does not), design waste management systems, and examine how people meet sustainable living challenges in diverse ways around the world. Science understanding and skills can be taught through experiments asking questions such as ‘Is compost alive?’, ‘Why do some compost piles generate heat?’ and ‘How does a working compost pile relate to the soil food web?’ We can collect data about hot compost temperature, and graph this over time.

Compost is mentioned several times in the elaborations to the Australian Curriculum, and these extracts below for years 1–7 provide a few examples of learning objectives we can teach, using the compost pile and related activities.

Design and Technologies

- Critique needs or opportunities for designing and explore and test a variety of materials, components, tools and equipment and the techniques needed to produce designed solutions (Yrs 3-4, ACTDEP014) 
- Investigate the suitability of materials, systems, components, tools and equipment for a range of purposes (Yrs 3-4, ACTDEK013) 
- Investigate how and why food and fibre are produced in managed environments (Yrs 5-6, ACTDEK021) 

Geography

- The sustainable management of waste from production and consumption (Yr 4, ACHGK025) 









Health and Physical Education

- Describe strategies to make the classroom and playground healthy, safe and active spaces (Yrs 3-4, ACPPSo40) 

Mathematics

- Collect data, organize into categories and create displays using lists, tables, picture graphs and simple column graphs, with and without the use of digital technologies (Yr 3, ACMSP069) 
- Use scaled instruments to measure and compare lengths, masses, capacities and temperatures (Yr 4, ACMMGo84) 

Science

- Living things live in different places where their needs are met (Yr 1, ACSSU211) 
- People use science in their daily lives, including when caring for their environment and living things (Yr 2, ACSHE035) 
- Heat can be produced in many ways and can move from one object to another (Yr 3, ACSSU049)
- Living things can be grouped on the basis of observable features and can be distinguished from non-living things (Yr 3, ACSSU044) 
- Safely use appropriate materials, tools or equipment to make and record observations, using formal measurements and digital technologies as appropriate (Yr 3, ACSIS055) 
- Living things have life cycles (Yr 4, ACSSU072) 
- Living things, including plants and animals, depend on each other and the environment to survive (Yr 4, ACSSU073) 
- Interactions between organisms can be described in terms of food chains and food webs; human activity can affect these interactions (Yr 7, ACSSU112) 
- Some of Earth’s resources are renewable, but others are non-renewable (Yr 7, ACSSU116) 

Cross-curriculum Priorities

- Sustainability

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